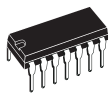
NE556
SA556 - SE556

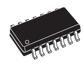
General-purpose dual bipolar timers

Features

- Low turn-off time
- Maximum operating frequency greater than 500 kHz
- Timing from microseconds to hours
- Operates in both astable and monostable modes
- Output can source or sink up to 200 mA
- Adjustable duty cycle
- TTL compatible
- Temperature stability of 0.005% per °C

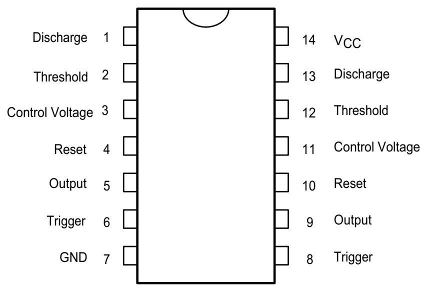


N
DIP14
(Plastic package)



D
SO14
(Plastic micropackage)

Pin connections
(top view)



Description

The NE556, SA556 and SE556 dual monolithic timing circuits are highly stable controllers capable of producing accurate time delays or oscillation. In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For a stable operation as an oscillator, the free running frequency and the duty cycle are both accurately controlled with two external resistors and one capacitor.

The circuits may be triggered and reset on falling waveforms, and the output structure can source or sink up to 200 mA.

1 Schematic diagrams

Figure 1. Block diagram

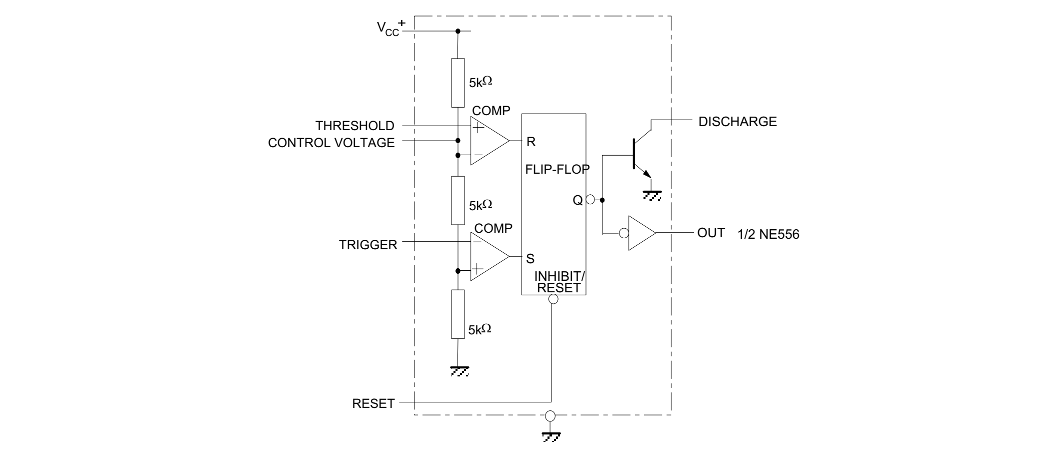
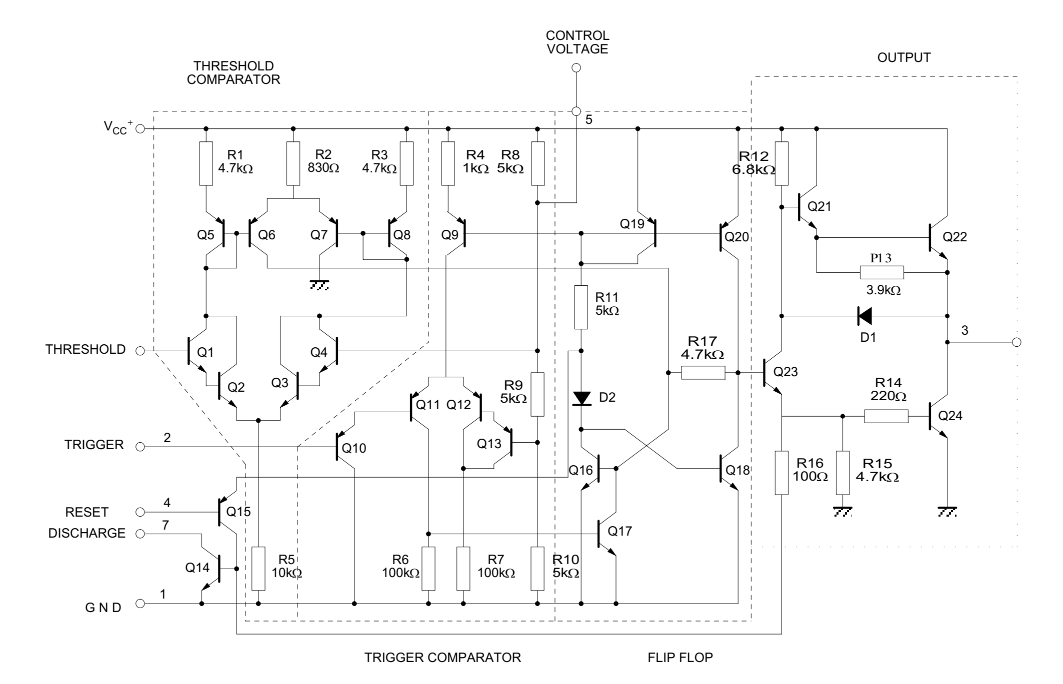


Figure 2. Schematic diagram



2 Absolute maximum ratings and operating conditions

Table 1. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	18	V
I_{OUT}	Output current (sink and source)	±225	mA
R_{thja}	Thermal resistance junction to ambient(1) DIP14 SO-14	 80 105	°C/W
R_{thjc}	Thermal resistance junction to case (1) DIP14 SO-14	 33 31	°C/W
ESD	Human body model (HBM)(2)	1000	V
	Machine model (MM)(3)	150	
	Charged device model (CDM)(4)	1500	
	Latch-up immunity	200	mA
T_{LEAD}	Lead temperature (soldering 10 seconds)	260	°C
T_j	Junction temperature	150	°C
T_{stg}	Storage temperature range	-65 to 150	°C

1. Short-circuits can cause excessive heating. These values are typical and valid only for a single layer PCB.
2. Human body model: a 100 pF capacitor is charged to the specified voltage, then discharged through a 1.5kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are floating.
3. Machine model: a 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω). This is done for all couples of connected pin combinations while the other pins are floating.
4. Charged device model: all pins and the package are charged together to the specified voltage and then discharged directly to the ground through only one pin. This is done for all pins.

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage NE556 SA556 SE556	 4.5 to 16 4.5 to 16 4.5 to 18	V
V_{th}, V_{trig}, V_{cl}, V_{reset}	Maximum input voltage	V_{CC}	V
I_{OUT}	Output current (sink and source)	±200	mA
T_{oper}	Operating free air temperature range NE556 SA556 SE556	 0 to 70 -40 to 105 -55 to 125	°C

3 Electrical characteristics

Table 3. T_{amb} = +25° C, V_{CC} = +5 V to +15 V (unless otherwise specified)

Symbol	Parameter	SE556			NE556 - SA556			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
I_{CC}	Supply current (RL ∞) (2 timers) Low state V_{CC} = +5V V_{CC} = +15V High State V_{CC} = +5V		 6 20 4	 10 24		 6 20 4	 12 30	mA
	Timing error (monostable) (R_A = 2kΩ to 100kΩ, C = 0.1µF) Initial accuracy (1) Drift with temperature Drift with supply voltage		 0.5 30 0.05	 2 100 0.2		 1 50 0.1	 3 0.5	 % ppm/°C %/V
	Timing error (astable) (R_A, R_B = 1kΩ to 100kΩ, C = 0.1µF, V_{CC}= +15V) Initial accuracy (1) Drift with temperature Drift with supply voltage		 1.5 90 0.15			 2.25 150 0.3		 % ppm/°C %/V
V_{CL}	Control voltage level V_{CC} = +15V V_{CC} = +5V	 9.6 2.9	 10 3.33	 10.4 3.8	 9 2.6	 10 3.33	 11 4	V
V_{th}	Threshold voltage V_{CC} = +15V V_{CC} = +5V	 9.4 2.7	 10 3.33	 10.6 4	 8.8 2.4	 10 3.33	 11.2 4.2	V
I_{th}	Threshold current (2)		0.1	0.25		0.1	0.25	µA
V_{trig}	Trigger voltage V_{CC} = +15V V_{CC} = +5V	 4.8 1.45	 5 1.67	 5.2 1.9	 4.5 1.1	 5 1.67	 5.6 2.2	V
I_{trig}	Trigger current (V_{trig} = 0V)		0.5	0.9		0.5	2.0	µA
V_{reset}	Reset voltage (3)	0.4	0.7	1	0.4	0.7	1	V
I_{reset}	Reset current V_{reset} = +0.4V V_{reset} = 0V		 0.1 0.4	 0.4 1		 0.1 0.4	 0.4 1.5	mA
V_{OL}	Low level output voltage V_{CC} = +15V $I_{O(sink)}$ = 10mA $I_{O(sink)}$ = 50mA $I_{O(sink)}$ = 100mA $I_{O(sink)}$ = 200mA V_{CC} = +5V $I_{O(sink)}$ = 8mA $I_{O(sink)}$ = 5mA		 0.1 0.4 2 2.5 0.1 0.05	 0.15 0.5 2.2 0.25 0.2		 0.1 0.4 2 2.5 0.3 0.25	 0.25 0.75 2.5 0.4 0.35	V
V_{OH}	High level output voltage V_{CC} = +15V $I_{O(sink)}$ = 200mA $I_{O(sink)}$ = 100mA V_{CC} = +5V $I_{O(sink)}$ = 100mA	 13 3	 12.5 13.3 3.3		 12.75 2.75	 12.5 13.3 3.3		V

Table 3. T_{amb} = +25° C, V_{CC} = +5 V to +15 V (unless otherwise specified) (continued)

Symbol	Parameter	SE556			NE556 - SA556			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
$I_{dis(off)}$	Discharge pin leakage current (output high) (V_{dis} = 10V)		20	100		20	100	nA
$V_{dis(sat)}$	Discharge pin saturation voltage (output low) (4) V_{CC} = +15V, I_{dis} = 15mA V_{CC} = +5V, I_{dis} = 4.5mA		 180 80	 480 200		 180 80	 480 200	mV
t_r t_f	Output rise time Output fall time		100 100	200 200		100 100	300 300	ns
toff	Turn-off time (5) (V_{reset} = V_{CC})		0.5			0.5		µs

1. Tested at V_{CC} = +5 V and VCC = +15 V
2. This will determine the maximum value of $R_A + R_B$ for +15V operation the max total is R = 20 MΩ and for +5 V operation the max total R = 3.5 MΩ
3. Specified with trigger input high
4. No protection against excessive pin 7 current is necessary, providing the package dissipation rating will not be exceeded
5. Time measured from a positive going input pulse from 0 to 0.8 x V_{CC} into the threshold to the drop from high to low of the output trigger is tied to threshold.

Figure 3. Minimum pulse width required for triggering

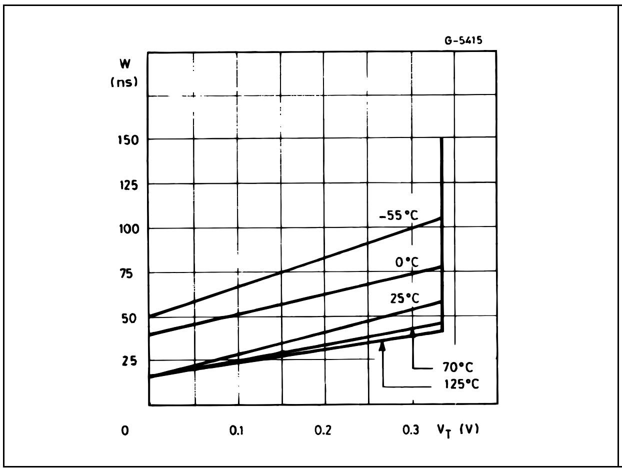


Figure 4. Supply current versus supply voltage

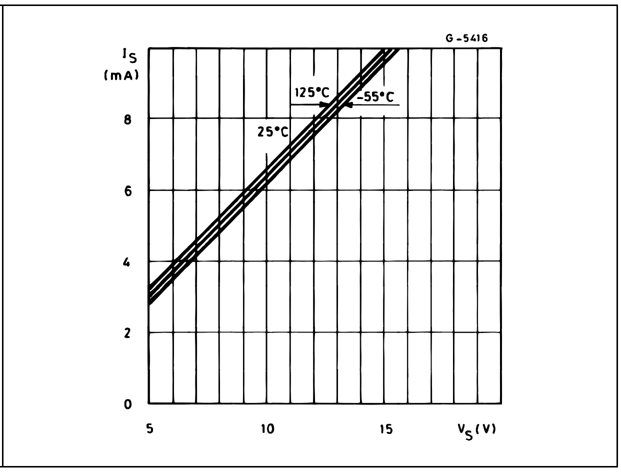


Figure 5. Delay time versus temperature

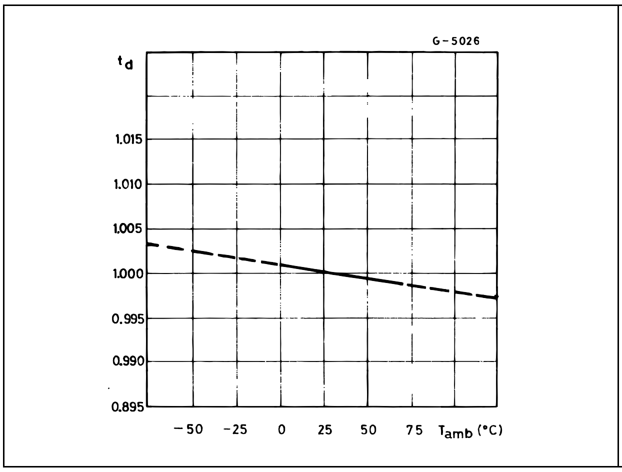


Figure 6. Low output voltage versus output sink current

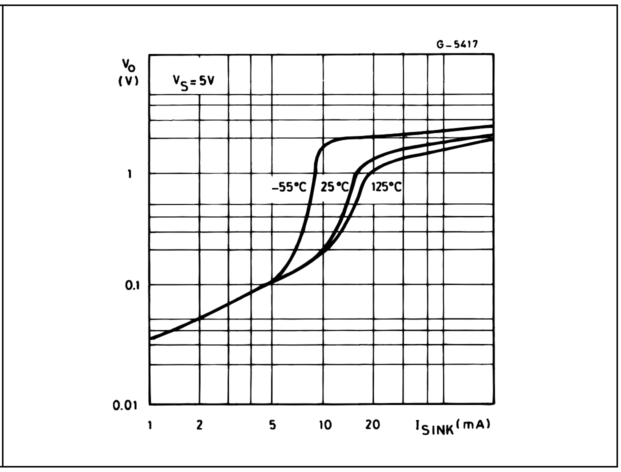


Figure 7. Low output voltage versus output sink current

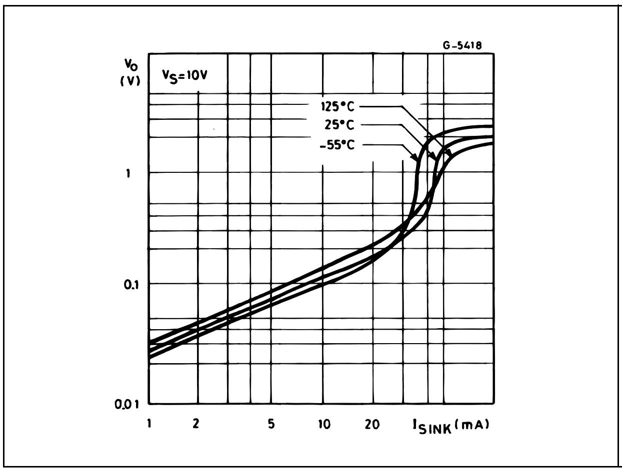


Figure 8. Low output voltage versus output sink current

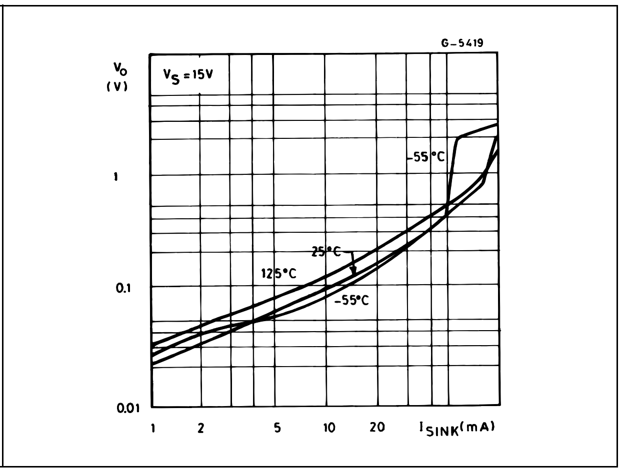


Figure 9. High output voltage drop versus output

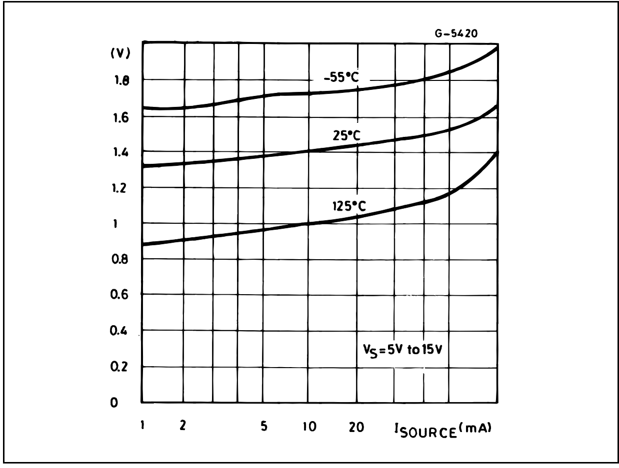


Figure 10. Delay time versus supply voltage

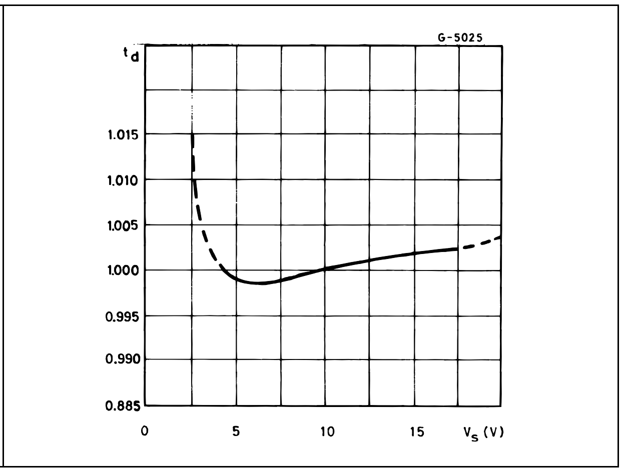
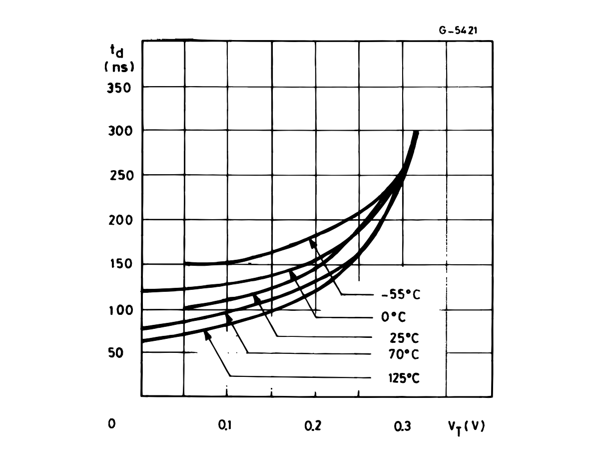


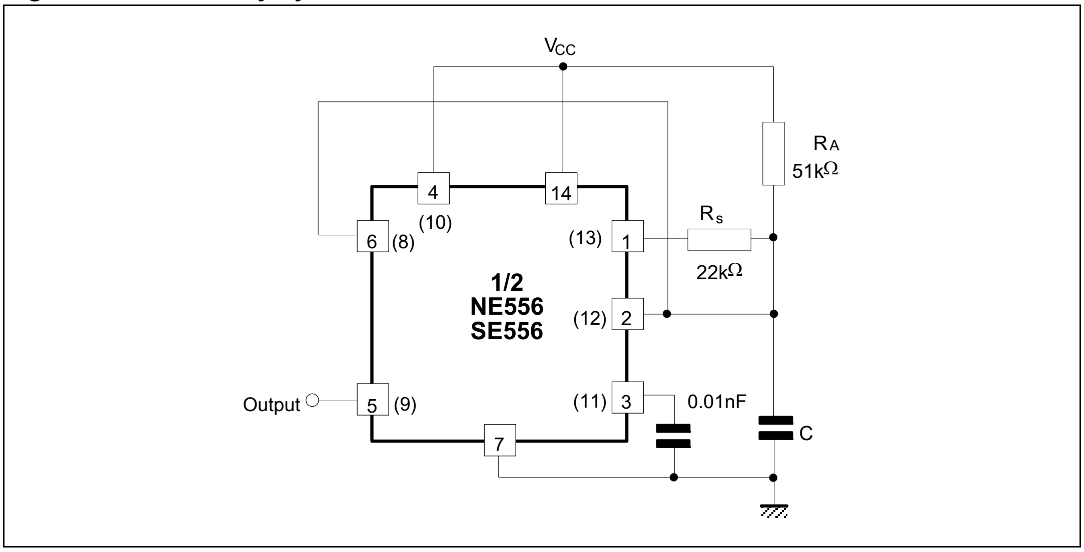
Figure 11. Propagation delay versus voltage level of trigger value



4 Application information

4.1 Typical application

Figure 12. 50% duty cycle oscillator



$t_1 = 0.693\ R_A.C$

$$t2 = [(RARB)/(RA+RB)]CLn\left[\frac{RB - 2RA}{2RB - RA}\right]$$

$$f = \frac{t1}{t1 + t2}\ RB < \frac{1}{2}\ RA\ ti$$

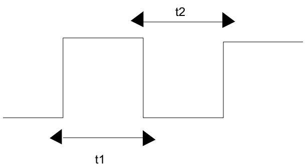


Figure 13. Pulse width modulator

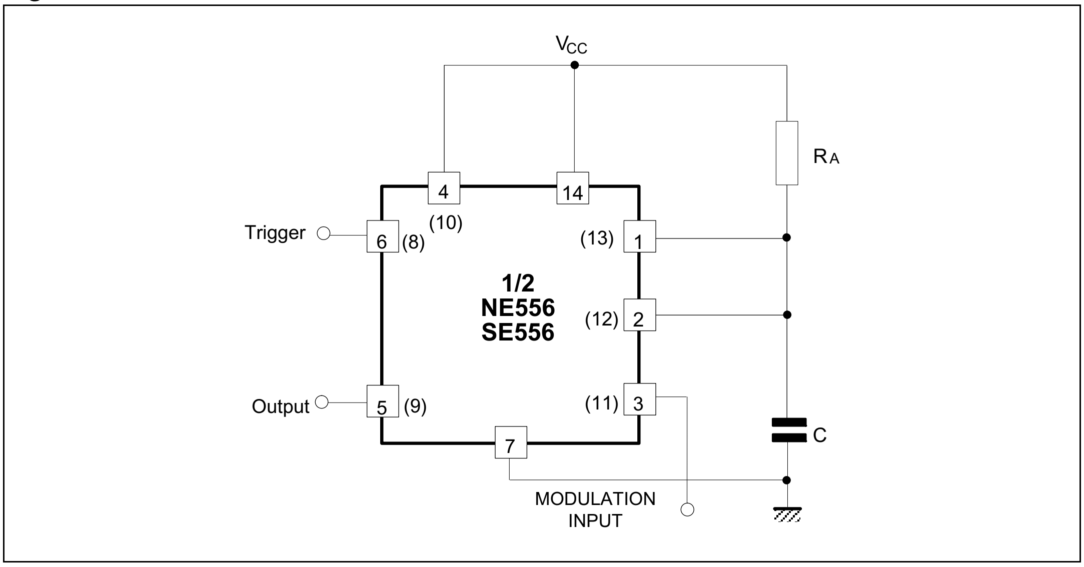
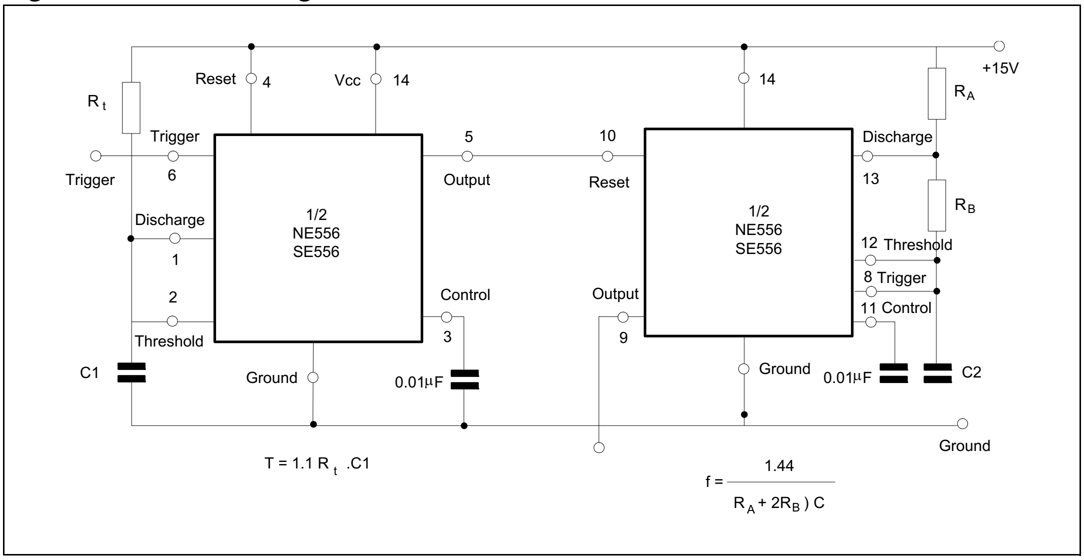


Figure 14. Tone burst generator



For a tone burst generator the first timer is used as a monostable and determines the tone duration when triggered by a positive pulse at pin 6. The second timer is enabled by the high output or the monostable. It is connected as an astable and determines the frequency of the tone.

Figure 15. Monostable operation

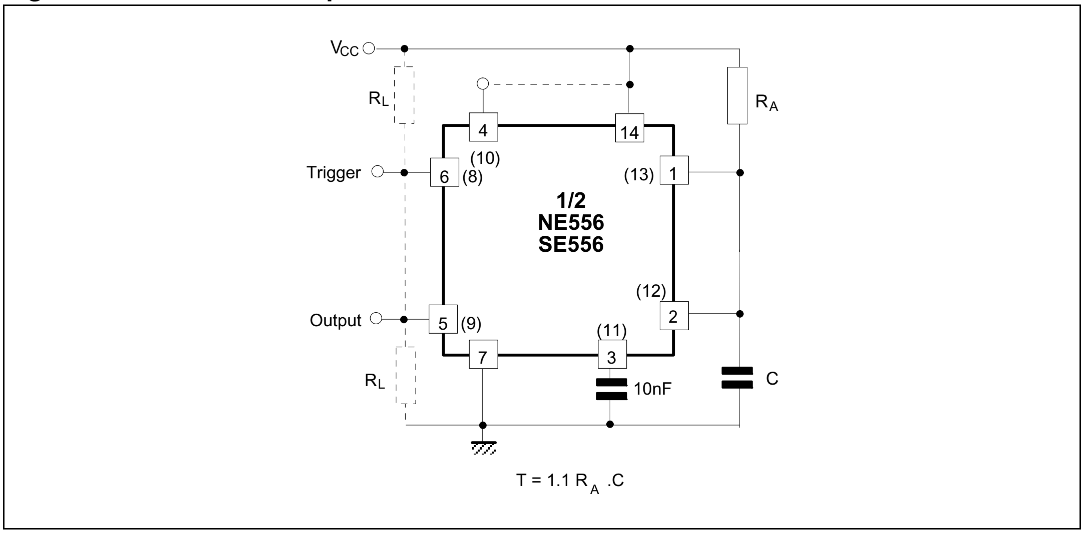
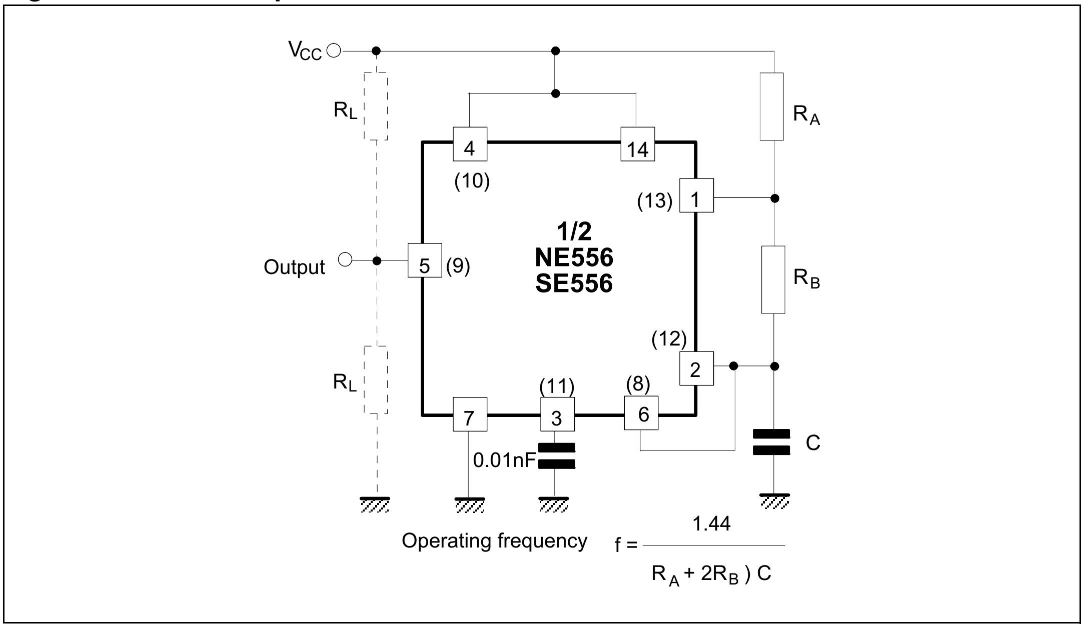
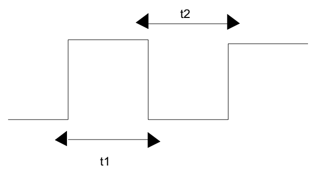


Figure 16. Astable operation



$t_1 = 0.693\ (R_A + R_B)\ C$ output high

$t_2 = 0.693\ R_B C$ output low



5 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

5.1 DIP14 package information

Figure 17. DIP14 package mechanical drawing

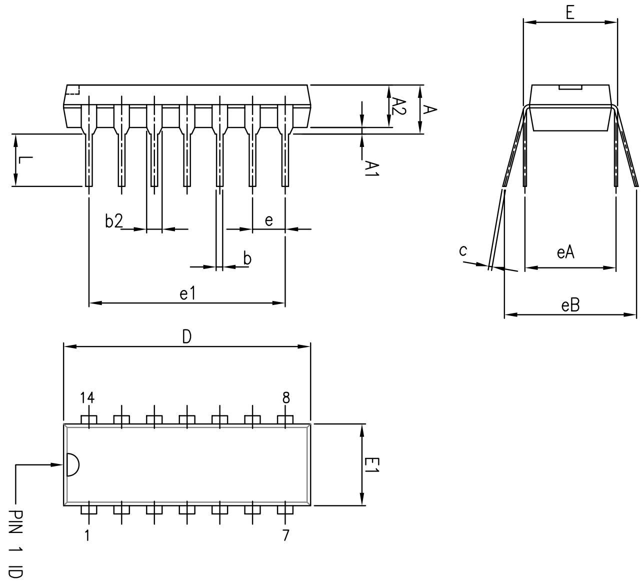


Table 4. DIP14 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			5.33			0.21
A1	0.38			0.015		
A2	2.92	3.30	4.95	0.11	0.13	0.19
b	0.36	0.46	0.56	0.014	0.018	0.022
b2	1.14	1.52	1.78	0.04	0.06	0.07
c	0.20	0.25	0.36	0.007	0.009	0.01
D	18.67	19.05	19.69	0.73	0.75	0.77
E	7.62	7.87	8.26	0.30	0.31	0.32
E1	6.10	6.35	7.11	0.24	0.25	0.28
e		2.54			0.10	
e1		15.24			0.60	
eA		7.62			0.30	
eB			10.92			0.43
L	2.92	3.30	3.81	0.11	0.13	0.15

Note: D and E1 dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.25 mm.

5.2 SO-14 package information

Figure 18. SO-14 package mechanical drawing

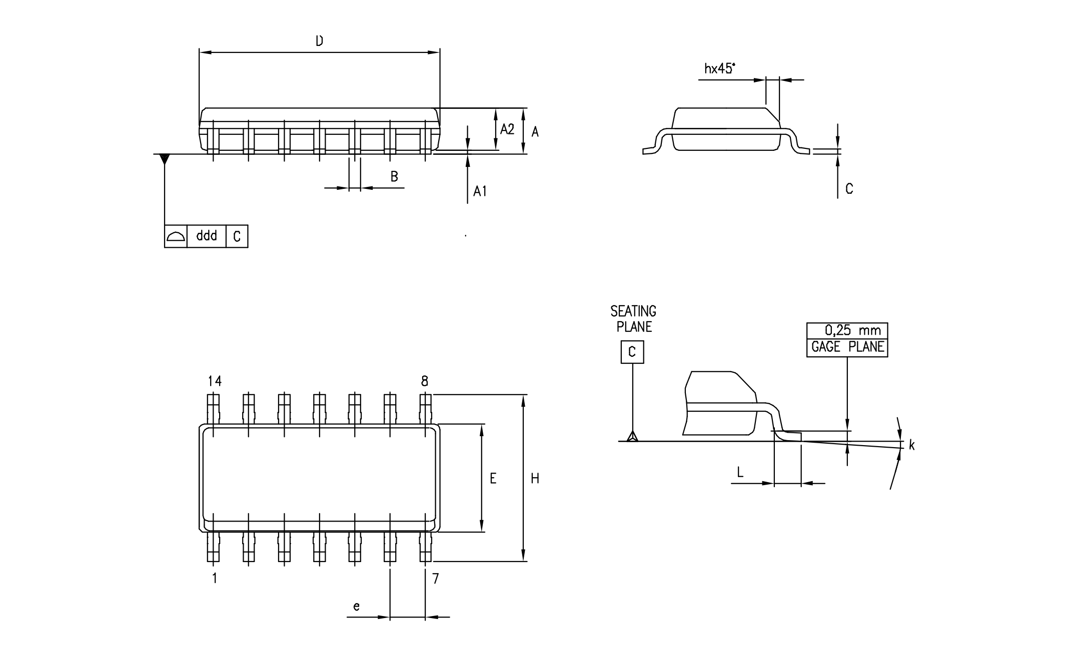


Table 5. SO-14 package mechanical data

Dimensions						
Ref.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	1.35		1.75	0.05		0.068
A1	0.10		0.25	0.004		0.009
A2	1.10		1.65	0.04		0.06
B	0.33		0.51	0.01		0.02
C	0.19		0.25	0.007		0.009
D	8.55		8.75	0.33		0.34
E	3.80		4.0	0.15		0.15
e		1.27			0.05	
H	5.80		6.20	0.22		0.24
h	0.25		0.50	0.009		0.02
L	0.40		1.27	0.015		0.05
k	8° (max.)					
ddd			0.10			0.004

Note: D and F dimensions do not include mold flash or protrusions. Mold flash or protrusions must not exceed 0.15 mm.

6 Ordering information

Table 6. Order codes

Part number	Temperature range	Package	Packing	Marking
NE556N	0°C, +70°C	DIP14	Tube	NE556N
NE556D/DT		SO-14	Tube or tape & reel	NE556
SA556N	-40°C, +105°C	DIP14	Tube	SA556N
SA556D/DT		SO-14	Tube or tape & reel	SA556
SE556N	-55°C, + 125°C	DIP14	Tube	SE556N
SE556D/DT		SO-14	Tube or tape & reel	SE556

7 Revision history

Table 7. Document revision history

Date	Revision	Changes
01-Jun-2003	1	Initial release.
27-Jan-2009	2	Document reformatted. Added I_{OUT} value in *Table 1: Absolute maximum ratings* and *Table 2: Operating conditions*. Added ESD tolerance, latch-up tolerance, R_{thja} and R_{thjc} in *Table 1: Absolute maximum ratings*. Updated *Section 5.1: DIP14 package information* and *Section 5.2: SO-14 package information*.

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